Aluminium oxide

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(Redirected from Alumina)

Alumina redirects here. It may also refer to Alumina Limited.

Aluminium oxide	
General	
Other names	Alumina, Aluminium(III) Oxide
Molecular formula	Al_2O_3
Molar mass	101.96 g/mol
CAS number	[[1344-28-1] [1] (http://webbook.nist.gov/cgi/cbook.cgi?ID=1344-28-1&Units=SI)]
Properties	
Density and phase	3.97 g/cm³, solid
Solubility in water	Insoluble.
Melting point	2054°C
Boiling point	~3000°C
Thermal Conductivity	18 W/m·K
Structure	
Coordination geometry	Octahedron.
Crystal structure	Cubic.
Thermodynamic data	
Standard enthalpy of formation $\Delta_f H^\circ_{solid}$	-1675.7 kJ/mol
Standard molar entropy S°_{solid}	50.92 J/(mol K)
Heat capacity C_p	79.04 J/(mol K)
Hazards	
MSDS	External MSDS
EU classification	Not listed.
NFPA 704	
Flash point	Non-flammable.
Supplementary data page	
Structure and properties	n, ε_r = 9.5, etc. Refractive index at different wavelengths
Thermodynamic data	Phase behaviour Solid, liquid, gas
Spectral data	UV, IR, NMR, MS
Related compounds	
Other anions	Aluminium hydroxide
Other cations	Boron trioxide Gallium oxide Indium oxide Thallium oxide

Related compounds	Aluminium hydroxide
Except where noted otherwise, data are given for materials in their standard state (at 25 °C, 100 kPa) Infobox disclaimer and references	

Aluminium oxide is a chemical compound of aluminium and oxygen with the chemical formula Al_2O_3. It is also commonly referred to as **alumina** in the mining, ceramic and materials science communities.

Contents

Properties

Aluminium oxide is an excellent thermal and electrical insulator. In its crystalline form, called corundum, its hardness makes it suitable for use as an abrasive and as a component in cutting tools.

Aluminium oxide is responsible for metallic aluminium's resistance to weathering. Metallic aluminium is very reactive with atmospheric oxygen, and a thin passivation layer of alumina quickly forms on any exposed aluminium surface. This layer protects the metal from further oxidation. The thickness and properties of this oxide layer can be enhanced using a process called anodising. A number of alloys, such as aluminium bronzes, exploit this property by including a proportion of aluminium in the alloy to enhance corrosion resistance.

Aluminium oxide was taken off the EPA's chemicals lists in 1988.

Natural occurrence

Corundum is the naturally occurring mineral form of aluminium oxide. Rubies and sapphires are gem-quality forms of corundum with their characteristic colors due to trace impurities in the corundum structure.

Industrial Fabrication Process

Aluminium oxide, also known as alumina, is the main component of bauxite, the principal ore of aluminium. The largest manufacturers in the world of alumina are Alcoa, Alcan and Rusal. Companies which specialise in the production of speciality aluminium oxides and aluminium hydroxides include Alcan and Almatis. The bauxite ore is made up of impure Al_2O_3, Fe_2O_3, and SiO_2. These are then purified by the Bayer Process:

$Al_2O_3 + 3H_2O + 2NaOH + \text{heat} \rightarrow 2NaAl(OH)_4$

The Fe_2O_3 does not dissolve in the base. The SiO_2 dissolves as silicate $Si(OH)_6^{2-}$. Upon filtering, Fe_2O_3 is removed. When the Bayer liquor is cooled, $Al(OH)_3$ precipitates. The silicate remains in solution. Then:

$2Al(OH)_3 + \text{heat} \rightarrow Al_2O_3 + 3H_2O$

The formed Al_2O_3 is alumina.

In 1961, GE developed "Lucalox", a transparent alumina used in sodium vapor lamps.

In August 2004, scientists in the United States working for 3M developed a technique for making an alloy of aluminium oxide and rare earth elements to produce a strong glass called transparent alumina.

Uses

Annual world production of alumina is approximately 65 million tonnes, over 90% of which is used in the manufacture of aluminium metal. Major uses for aluminium hydroxide include the manufacture of water treatment chemicals such as aluminium sulphate, Poly Aluminium Chloride and sodium aluminate. Large tonnnages are also used in the manufacture of zeolites, coating titania pigments and as a fire retardants/smoke suppressant. The major uses of speciality aluminium oxides are in refractories, ceramics, polishing and abrasive applications. Minor uses include use in toothpaste formulations, and as a medium for chromatography. In this latter application alumina is available in the so-called Brockmann types neutral, basic (pH 9.5) and acidic (pH 4.5 when in water). Aluminium oxide is also used in preparation of coating suspensions in compact fluorescent lamps.

Commercial Uses

Aluminium oxide is used in certain CD/DVD cleaning kits, for example, Memorex's Optifix Pro. This chemical will repair damaged CDs/DVDs with greater efficacy than Isopropyl alcohol.

External links

- International Chemical Safety Card 0351 (http://www.ilo.org/public/english/protection/safework/cis/products/icsc/dtasht/_icsc03/icsc0351.htm)
- PhysicsWeb article on Transparent alumina (http://physicsweb.org/article/news/8/8/9)* Sigma-Aldrichalumina grades commercial supplier (http://www.sigmaaldrich.com/catalog/search/SearchResultsPage/PricingAvailability/SIAL;199974)
- Logitech, calcined, fused and ultra-fine aluminium oxide suppliers (http://www.logitech.uk.com/productcart/pc/viewCat_h.asp?idCategory=2)
- Alcan Specialty Aluminas (commercial supplier) (http://www.specialty-aluminas.alcan.com/gardanne/WebSpecialtyGlobal.nsf/0/D7567638D905C3B9C1256ED6004EF8DF/$file/index_content.htm?open#en)

- Link page to external chemical sources.

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